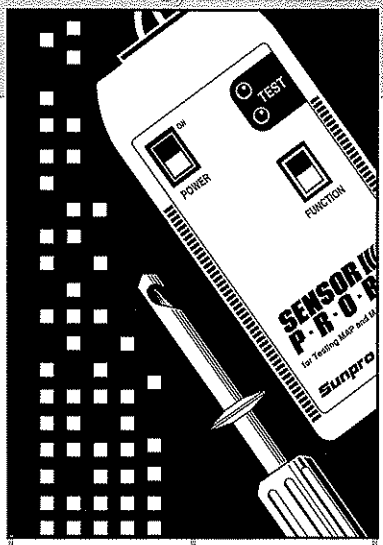
Sunpro by actron



CP9085

SENSOR P·R·O·B·E™

Instructions in English and Spanish

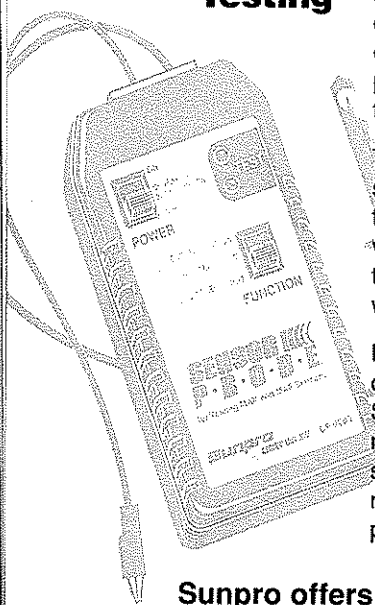
Instrucciones en Español e Inglés

Introduction

Sunpro®

SENSOR PROBE™

On-Vehicle Sensor Testing



Congratulations on purchasing your Sunpro® Sensor Probe for testing vehicle sensors. Your Sunpro® Sensor Probe is made by Actron, the largest and most trusted name in automotive diagnostic equipment for the home mechanic. You can have confidence this 100% Made-In-America product maintains the highest quality in manufacturing and will provide years of reliable service.

This instruction manual is divided into several key sections. You will find detailed steps on using the the Sensor Probe for checking many types of vehicle sensors. Also included is important information about sensor operation, common problems which occur if they fail and troubleshooting tips.

Locating driveability problems requires inspection of both mechanical and electronic parts. The Sensor Probe is valuable for finding failures in many important electronic components. You can save yourself a lot of costly time and money in auto repairs. And feel confident that your vehicle's problem has been fixed!

Sunpro offers a complete line of high quality automotive diagnostic and repair equipment. See your local dealer for other Sunpro products.

All information, illustrations and specifications contained in this manual are based on the latest information available from industry sources at the time of publication. No warranty (expressed or implied) can be made for its accuracy or completeness, nor is any responsibility assumed by Actron Manufacturing Co. or anyone connected with it for loss or damages suffered through reliance on any information contained in this manual or misuse of accompanying product. Actron Manufacturing Co. reserves the right to make changes at any time to this manual or accompanying product without obligation to notify any person or organization of such changes.

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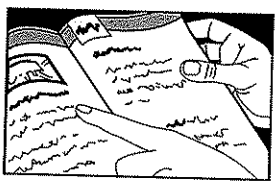
Vehicle Service Info

The following is a list of publishers who have manuals containing electronic engine control, ignition system and related information. Some manuals may be available at auto parts stores or your local public library. For others, you need to write for availability and prices, specifying the make, style and model year of your vehicle.

Vehicle Service Manuals



Chilton Book Company
Chilton Way
Radnor, PA 19089

Haynes Publications
861 Lawrence Drive
Newbury Park, CA 91320

"Electronic Engine Controls"
"Fuel Injection and Feedback Carburetors"
"Fuel Injection and Electronic Engine Controls"
"Emissions Control Manual"
...or similar titles

Cordura Publications
Mitchell Manuals, Inc.
Post Office Box 26260
San Diego, CA 92126

Motor's Auto Repair Manual
Hearst Company
250 W. 55th Street
New York, NY 10019

Service manuals from General Motors Corporation

Buick
Tuar Company
Post Office Box 354
Flint, MI 48501

Oldsmobile
Lansing Lithographers
Post Office Box 23188
Lansing, MI 48909

Cadillac, Chevrolet, Pontiac
Helm Incorporated
Post Office Box 07130
Detroit, MI 48207

All GM manuals: Ignition system information in Section 6D. Electronic engine control information in Section 6E.

Service manuals from Ford Motor Company

Ford Publication Department
Helm Incorporated
Post Office Box 07150
Detroit, MI 48207

1985 & Newer: "Emission Diagnosis Engine/ Electronics"
1981 - 1984: "Engine/Emissions Diagnosis"
1980: "Engine Diagnosis/Emissions"

Service manuals from Chrysler Corporation

Chrysler Corporation
Dyment Distribution Service
Service Publication
12200 Alameda Drive
Strongsville, Ohio 44136

General Safety Guidelines to Follow When Working on Vehicles

- Always wear approved eye protection.
- Always operate the vehicle in a well ventilated area. Do not inhale exhaust gases - they are very poisonous!
- Always keep yourself, tools and test equipment away from all moving or hot engine parts.
- Always make sure the vehicle is in **park** (Automatic transmission) or **neutral** (manual transmission) and that the **parking brake is firmly set.** Block the drive wheels.
- Never lay tools on vehicle battery. You may short the terminals together causing harm to yourself, the tools or the battery.
- Never smoke or have open flames near vehicle. Vapors from gasoline and charging battery are highly flammable and explosive.
- Never leave vehicle unattended while running tests.
- Always keep a fire extinguisher suitable for gasoline/electrical/chemical fires handy.
- Always turn ignition key OFF when connecting or disconnecting electrical components, unless otherwise instructed.
- Always follow vehicle manufacturer's warnings, cautions and service procedures.

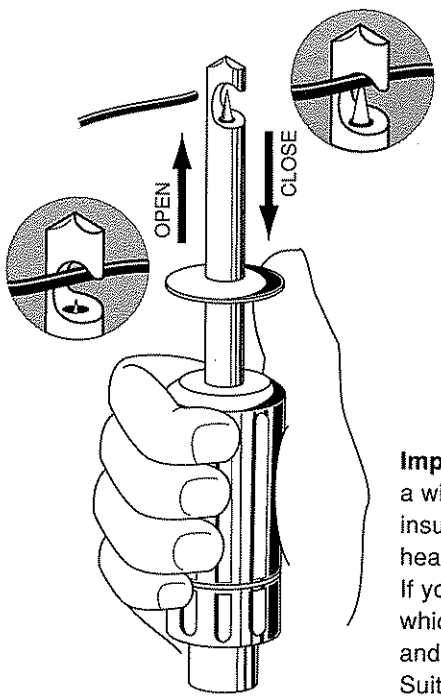
CAUTION:
Some vehicles are equipped with safety air bags. You *must* follow vehicle service manual cautions when working around the air bag components or wiring. If the cautions are not followed, the air bag may open up unexpectedly, resulting in personal injury. Note that the air bag can still open up several minutes after the ignition key is off (or even if the vehicle battery is disconnected) because of a special energy reserve module.

Section 1 Tester Basics

This section contains a general description of the Sensor Probe. Other manual sections detail HOW to use the unit for various tests.

Using the RED Test Lead

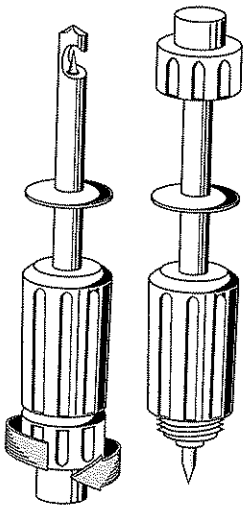
The Sensor Probe has a unique 2-way test lead. Circuit connections are made using either a piercing or probing action.



Piercing - used when no exposed circuit test points are available.

- Push up on probe tip.
- Insert wire being tested into hook.
- Release probe tip. The spring inside the probe will close the hook and pierce the wire insulation. (Tough insulations may sometimes require a *gentle* squeezing assist on the probe tip to make contact.)
- Push up on the probe tip to release wire.

Important: Attaching the piercing probe to a wire creates a small hole in the wire insulation. Some wire insulations are "self-healing" - the hole will disappear over time. If you wish to seal the hole, use a product which can withstand high temperatures and contain NO corrosive chemicals. Suitable products include: GE General Purpose Paste (# IS 802 White, IS 803 Black or IS 808 Translucent) or GE Non-Corrosive Paste # RTV 162 White.



Probing - used when circuit test points are readily accessible.

- Unscrew cap at probe handle bottom to reveal test prod. (Temporarily store cap by pushing it onto piercing tip.)
- Use test prod to probe desired circuit points.
- Replace cap to probe handle bottom when finished.

① POWER switch

This switch controls power to the tester.

- **OFF** - No power is supplied to the tester.
- **CONTINUITY/9V BATT. CHECK** - Tester can perform continuity tests (see section 7) *or* check voltage of 9 volt battery inside tester (see page 1-4).
- **ON** - Tester is powered up and ready for use.

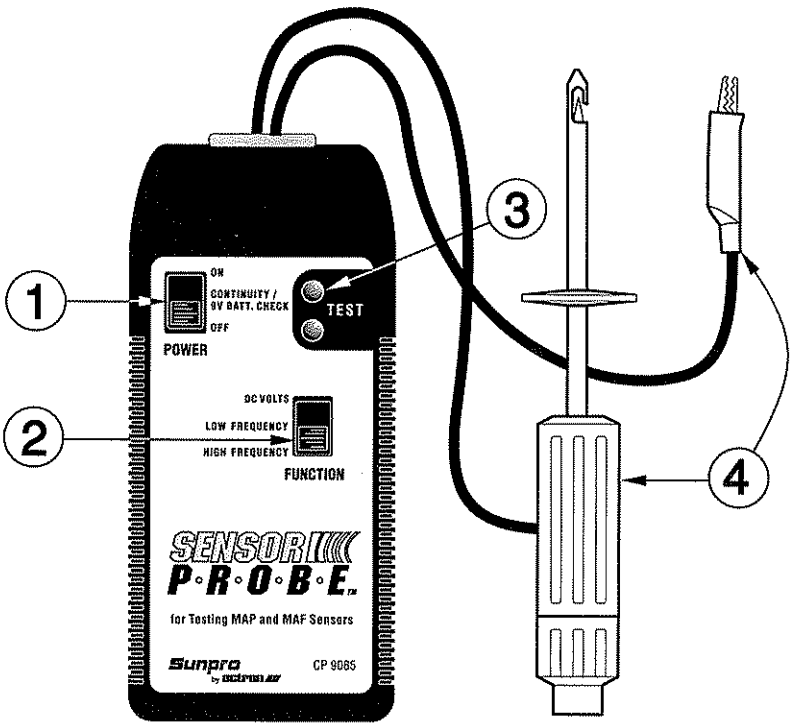
② FUNCTION switch

This switch selects the type of sensor signal being tested.

- **DC** - For dc voltage type sensor signals.
- **LOW FREQUENCY** - For frequency type sensor signals in the range of 0 to 220 Hz.
- **HIGH FREQUENCY** - For frequency type sensor signals in the range of 0 to 10 kHz.

③ TEST Lights

Used to indicate results of various tests and checks. One or both lights will have *on*, *off* or *variable* brightness (depending upon test type).



④ Test Leads

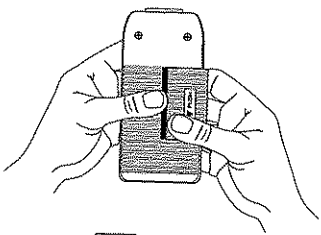
These are used for the various tests and checks.

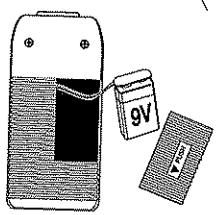
- **RED** - The SIGNAL lead. Circuits probed by this lead cause the TEST lights to react.
- **BLACK** - The COMMON lead. Used as a circuit ground or signal reference point for all tests and checks.

Sensor Probe Power

A 9 volt transistor radio battery (NEDA 1604) is required to power the unit. Use an alkaline battery for longest operating life. The battery must be installed before use.

Installing the Battery

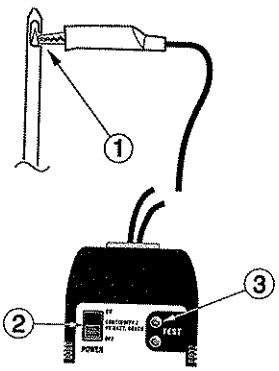




Do the following:

1) Hold the tester face down with both hands as shown.
2) Using both thumbs, firmly push downwards and outwards on the battery compartment door at the center of the tester. (*Not* on the word "PUSH.")
3) Slide the battery compartment door sideways to remove.
4) Attach battery to connector and install inside compartment.
5) Replace battery door. Slide door sideways until it snaps closed.

Checking the Battery



Do the following:

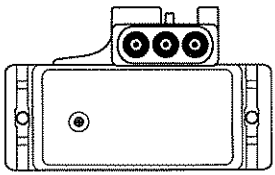
1) Connect the BLACK test lead to the metal tip on the RED test lead.
2) Slide the POWER switch to the CONTINUITY/ 9V BATT. CHECK position. (FUNCTION switch may be in any position.)
3) Look at the upper TEST light. If the upper light is ON (whether bright or very dim), the battery is O.K. for use. Replace battery if upper test light is off.

IMPORTANT: To conserve battery life, always turn POWER switch to OFF when not using the Sensor Probe.

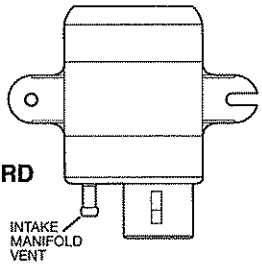
Section 2 Testing MAP or BARO Sensors

Referred to as Manifold Absolute Pressure (MAP) sensor, Barometric Pressure sensor (BARO, BPS) or similar names.

GM/ CHRYSLER



FORD



TYPICAL MAP SENSORS

What is It?

This sensor is an electronic module which sends a signal to the computer indicating atmospheric pressure and/or engine vacuum. Depending upon sensor type, the signal may be a dc voltage or a frequency. More pressure (less vacuum) makes the sensor signal increase (higher voltage or frequency). This is a 3-wire sensor.

How is it Used?

The computer needs to know air pressure both outside and inside the manifold to properly adjust air/fuel mixture and ignition timing for varying engine load and altitude conditions.

Location

The sensor is mounted either on the air cleaner, fire wall, inner fender or elsewhere in the engine compartment. Exception: Early Chrysler computer vehicles had the MAP sensor mounted near the computer - behind the passenger compartment kick panel. A vacuum hose connects the MAP sensor to a strong source of manifold vacuum. (Some new MAP sensor types may be directly mounted to the manifold, eliminating the vacuum hose connection.) The BARO sensors are vented to atmosphere - there is no vacuum hose attached.

When to Check

Related trouble codes sent by computer. Driveability problems such as hard starting, stalling, rough idle, hesitation, stumble, surging, poor fuel economy, black exhaust smoke, knocking, backfiring, catalytic converter overheating or no torque converter lock-up.

Map/Baro Sensor Test Procedures

Important: *Sensor remains mounted on vehicle and connected to wiring harness!*

Warning: *Test involves running engine. Observe all safety precautions (see page iv). Work in well ventilated area.*

1) **Ignition key OFF.**

2) **Check Sensor Probe battery.**
   - Refer to Section 1, page 1-4.

3) **Set switches:**
   - POWER switch OFF.
   - FUNCTION switch on DC VOLTS (GM/Chrysler) *or* LOW FREQUENCY (Ford).

4) **Connect test leads.**
   - BLACK test clip to good vehicle ground. (Negative terminal on vehicle battery is best.)
   - RED test probe: pierce sensor signal wire (center wire in sensor harness connector).
   - Make sure all connections are good!

5) **POWER switch ON.**

6) **Ignition key ON but DO NOT START ENGINE.**
   - Observe TEST lights – compare to TEST RESULTS chart.

7) **MAP sensor only:**
   - Start engine – let idle.
   - Observe TEST lights – compare to TEST RESULTS chart.
   - Rev engine momentarily.
   - Observe TEST lights – compare to TEST RESULTS chart.

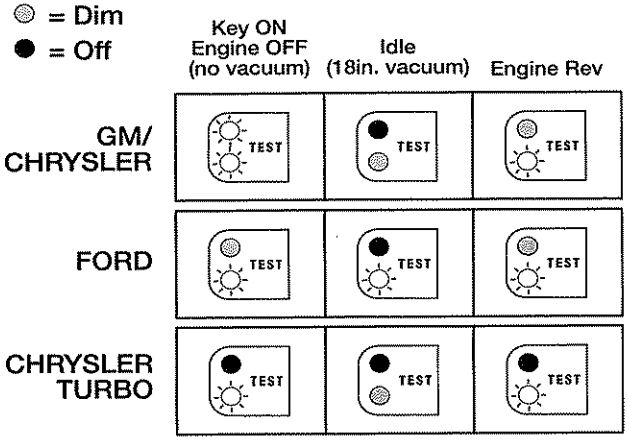
   BARO sensor only:
   - Attach hand vacuum pump to sensor vacuum port.
   - Apply 18 in. vacuum.
     Caution: more than 25 in. vacuum may harm sensor.
   - Observe TEST lights – compare to TEST RESULTS chart.

8) **Ignition key OFF – Evaluate test results (see next page).**
   - POWER switch OFF.
   - Disconnect RED test probe.

Test Results

Chart shows typical results. Actual performance may vary due to test conditions.

☼ = Bright
◌ = Dim
● = Off



Action to Take

TEST lights O.K.

- Sensor is functional.
- Testing is complete. Disconnect Sensor Probe.

NOTE: If TEST lights are O.K. but a computer trouble code indicates a bad sensor signal, the wire between the sensor signal pin and the computer may be open.

TEST lights NOT O.K.

- Additional checks necessary to pinpoint problem.

1) Check sensor vacuum hose, if used (see next page). *If O.K. then...*
2) Check sensor connectors (see next page). *If O.K. then...*
3) Check sensor power, ground and signal circuits (see next page). *If O.K. then...*
4) Replace bad sensor.

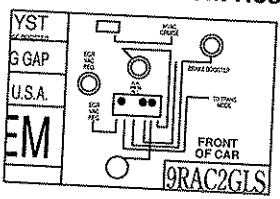
Additional checks to make if test results are not O.K.

Make these checks to avoid replacing a good sensor!

IMPORTANT: *Observe all safety precautions (see page iv).*

1) Ignition key OFF.

Check for Vacuum Hose Problems (if used)

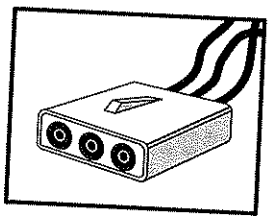


2) Check MAP sensor vacuum hose for:

- Correct routing. Refer to Vehicle Emission Control Information (VECI) decal located in the engine compartment.
- Pinches, kinks or collapsed sides.
- Splits, cuts or breaks.
- Clogs.

Repair as necessary, then retest. If no trouble found, proceed to next step.

Check for Connector Problems

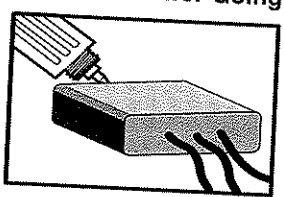


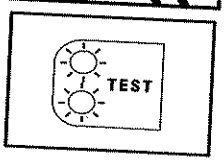
3) Disconnect sensor harness connector.

- Check connector for:
  - Corrosion on pins.
  - Bent or damaged pins.
  - Contacts not properly seated in housing.
  - Bad wire crimps to terminals.

Repair as necessary, then retest. If no trouble found, proceed to next step.

Check for Power Going to Sensor





4) Verify BLACK test clip connected to good vehicle ground.

5) Ignition key ON - but DO NOT START ENGINE.

6) POWER switch ON
FUNCTION switch on DC VOLTS.

7) Touch RED probe to power pin in sensor harness connector.

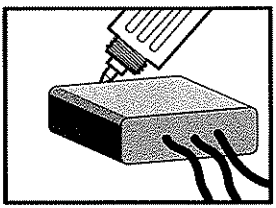
- Good Power Circuit: Both TEST lights ON brightly.

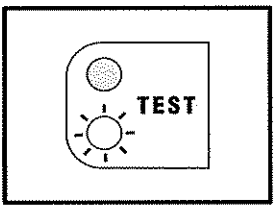
Proceed to next step.

- Bad Power Circuit: One or both TEST lights OFF or dim.

Repair open or short in power circuit wiring, then retest.

Check For Good Sensor Ground





8) Ignition key OFF.

9) Verify BLACK test clip connected to good vehicle ground.

10) POWER switch on CONTINUITY / 9V BATT. CHECK.

- FUNCTION switch in any position.

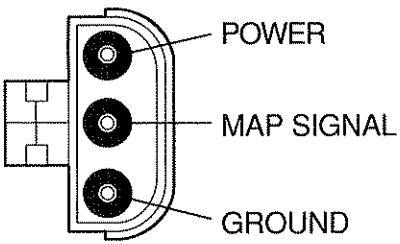
11) Touch RED probe to ground pin in sensor harness connector.

- Good Ground Circuit: Lower TEST light ON brightly.

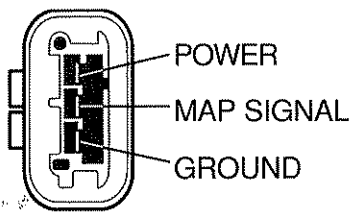
Proceed to next step.

- Bad Ground Circuit: Lower TEST light OFF.

Repair open in ground circuit wiring, then retest.



GM/Chrysler MAP Sensor Harness Connector



Ford MAP Sensor Harness Connector

Check for Sensor Signal Wire Shorts to Chassis Ground, Sensor Ground or Sensor Power

NOTE: Short circuits in the sensor signal wire rarely occur. This test is shown for reference, but it may be skipped with little chance of missing a potential problem.

12) **Verify Ignition key OFF.**

13) **Disconnect vehicle harness connector from engine computer.**

14) **Verify POWER switch on CONTINUITY / 9V BATT. CHECK.**
- FUNCTION switch in any position.

15) **RED probe to sensor signal pin (harness connector), BLACK clip to good chassis ground.**
- Good circuit (no short): Lower TEST light OFF.
- Bad circuit (shorted): Lower TEST light ON brightly.

16) **RED probe to sensor signal pin (harness connector), BLACK clip to sensor ground pin (harness connector).**
- Good circuit (no short): Lower TEST light OFF.
- Bad circuit (shorted): Lower TEST light ON brightly.

17) **RED probe to sensor power pin (harness connector), BLACK clip to sensor signal pin (harness connector).**
- Good circuit (no short): Lower TEST light OFF.
- Bad circuit (shorted): Lower TEST light ON brightly.

Repair wiring shorts if necessary, then retest. If no trouble found, proceed to next step.

18) Disconnect Sensor Probe, reconnect engine computer and sensor.

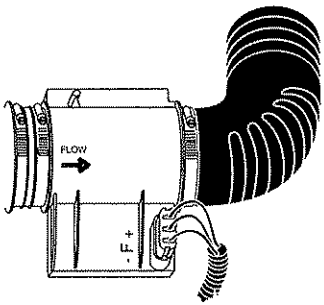
Action to Take

If the preceding Additional Checks are all good (but the sensor test is not O.K.) then the sensor is bad and needs to be replaced.

Section 3

Testing MAF Sensors

Referred to as Mass Air Flow (MAF) sensor.



TYPICAL MAF SENSOR

What is It?

This sensor is an electronic module which sends a signal to the computer indicating the amount of air entering the engine. Depending upon sensor design, the signal may be a dc voltage, low frequency or high frequency type. The signal level increases (higher voltage or frequency) as the air flow increases. This can be 3, 4 or 5 wire sensor. (Note: Some MAF sensor modules also contain an air temperature sensor. Refer to section 6 for temperature sensor test steps.)

How is it Used?

The computer needs to know incoming air flow to properly adjust air/fuel mixture and ignition timing for varying engine load and operating conditions.

Location

The sensor is mounted in the engine incoming air duct – between the air cleaner and the throttle body.

When to Check

Related trouble codes sent by computer. Driveability problems such as hard starting, stalling, rough idle, hesitation, stumble, surging, poor fuel economy, black exhaust smoke, knocking, backfiring, catalytic converter overheating or no torque converter lock-up.

MAF SENSOR TEST PROCEDURE

***Important**: Sensor remains mounted on vehicle and connected to wiring harness!*

***Warning:** Test involves running engine. Observe all safety precautions (see page iv). Work in well ventilated area.*

1) **Ignition key OFF.**

2) **Check Sensor Probe battery.**
   - Refer to Section 1, page 1-4.

3) **Set switches:**
   - POWER switch OFF.
   - FUNCTION switch on DC VOLTS, LOW FREQUENCY or HIGH FREQUENCY. (Refer to page 3-4 for sensor type.)

4) **Connect test leads.**
   - BLACK test clip to good vehicle ground. (Negative terminal on vehicle battery is best.)
   - RED test probe: pierce MAF signal wire. (Refer to page 3-4.)
   - Make sure all connections are good!

5) **POWER switch ON.**

6) **Ignition key ON but DO NOT START ENGINE.**
   - Observe TEST lights - compare to TEST RESULTS chart.

7) **Start engine - let idle.**
   - Observe TEST lights – compare to TEST RESULTS chart.
   - If TEST light brightness changes erratically during steady idle, then the sensor is defective and should be replaced.

8) **Gently tap sensor with a lightweight tool.**
   - If TEST light brightness changes erratically when the sensor is gently tapped, then the sensor is defective and should be replaced.

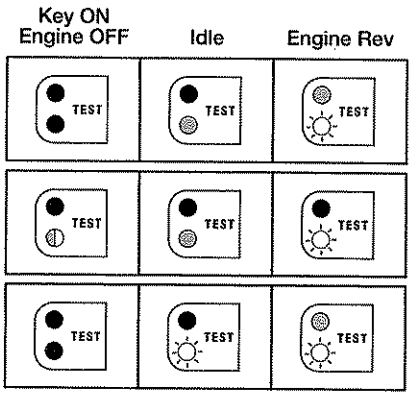
9) **Rev engine momentarily.**
   - Observe TEST lights - compare to TEST RESULTS chart.

10) **Ignition key OFF – Evaluate test results (see next page).**
   - POWER switch OFF.
   - Disconnect RED test probe.

TEST RESULTS

Chart below shows typical results. Actual performance may vary due to test conditions.

☼ = Bright
◎ = Dim
● = Off
◐ = Blinking



ACTION TO TAKE

TEST lights O.K.

- MAF sensor is functional.
- Testing is complete. Disconnect Sensor Probe.

NOTE: If TEST lights are O.K. but a computer trouble code indicates a bad sensor signal, the wire between the MAF sensor signal pin and the computer may be open. (Bosch 5-Pin or Ford sensor: Possible open in MAF return wire, also.)

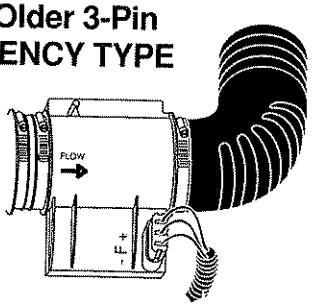
TEST lights NOT O.K.

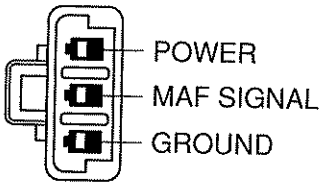
- Additional checks necessary to pinpoint problem.

1) **Check intake air path (page 3-6).** If O.K. then...
2) **Check sensor connectors (page 3-6).** If O.K. then...
3) **Check sensor power, ground and signal circuits (starts on page 3-6).** If O.K. then...
4) **Replace bad MAF sensor.**

GM: 1988 & Older 3-Pin LOW FREQUENCY TYPE

(AC-Delco)

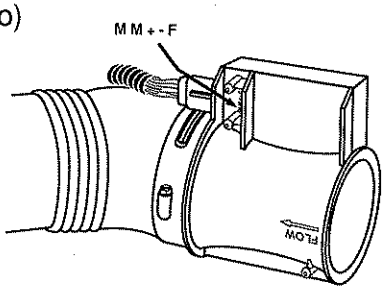




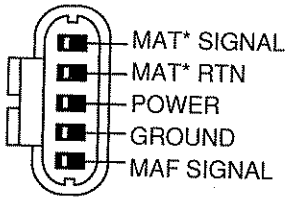
Harness Connector

GM: 1988 2.8L 5-Pin only LOW FREQUENCY TYPE

(AC-Delco)



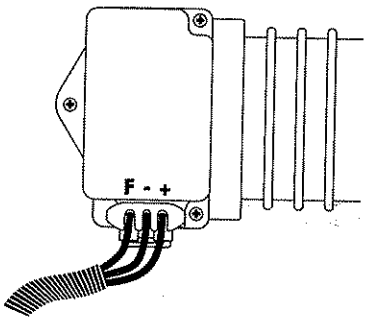
*Manifold Air Temperature

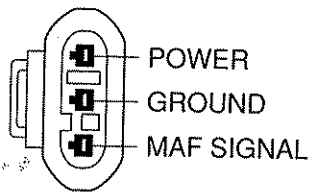


Harness Connector

GM: 1989 & Newer 3-Pin HIGH FREQUENCY TYPE

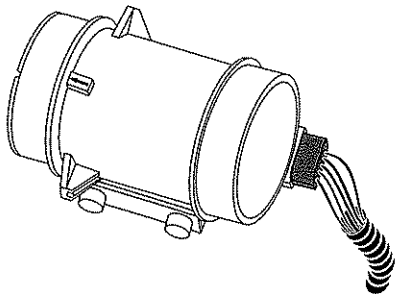
(Hitachi)

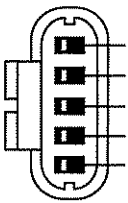




Harness Connector

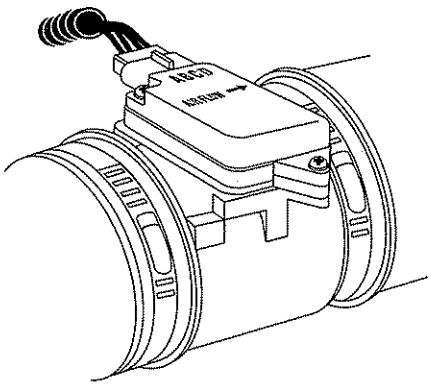
GM: All 5-Pin except 1988 2.8L
DC VOLTS TYPE
(Bosch)

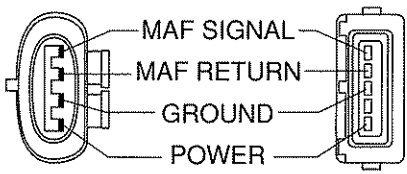




Harness Connector

FORD: 1989 & Newer
DC VOLTS TYPE





Harness Connector (2 types)

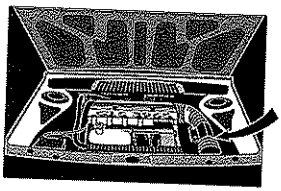
NOTE: MAF return is not connected to ground.

ADDITIONAL CHECKS TO MAKE IF TEST RESULTS ARE NOT O.K.

Make these checks to avoid replacing a good sensor!

IMPORTANT: *Observe all safety precautions (see page iv).*

Check for Air Intake Problems

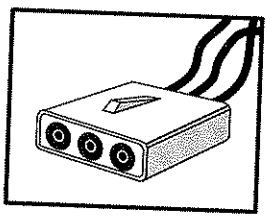


1) **Ignition key OFF.**

2) **Check for:**
   - Air leaks – around MAF sensor, ductwork or throttle body.
   - Obstructions in air duct.
   - Clogged air filter.

Repair as necessary, then retest. If no trouble found, proceed to next step.

Check for Connector Problems



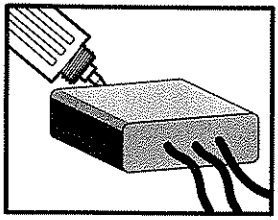
3) **Disconnect MAF harness connector.**
   - Check connector for:
   - Corrosion on pins.
   - Bent or damaged pins.
   - Contacts not properly seated in housing.
   - Bad wire crimps to terminals.

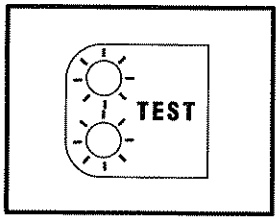
Repair as necessary, then retest. If no trouble found, proceed to next step.

Check for Power Going to Sensor

4) **Verify BLACK test clip connected to good vehicle ground.**

5) **Ignition key ON – but DO NOT START ENGINE.**





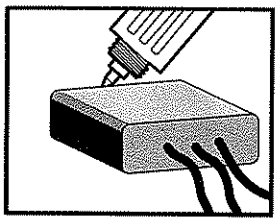
6) **POWER switch ON.**
FUNCTION switch on DC VOLTS.
7) **Touch RED probe to power pin in MAF harness connector.**
- **Good Power Circuit:** Both TEST lights ON brightly.

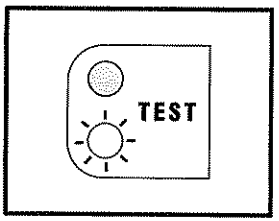
Proceed to next step.

- **Bad Power Circuit:** One or both TEST lights OFF or dim.

Repair open or short in power circuit wiring, then retest.

Check For Good Sensor Ground





8) **Ignition key OFF.**
9) **Verify BLACK test clip connected to good vehicle ground.**
10) **POWER switch on CONTINUITY / 9V BATT. CHECK.**
- FUNCTION switch in any position.

11) **Touch RED probe to ground pin in MAF harness connector.**

NOTE: Probe MAF ground pin not MAF *return* pin used on Bosch 5-Pin and Ford sensor connectors.

- **Good Ground Circuit:** Lower TEST light ON brightly.

Proceed to next step.

- **Bad Ground Circuit:** Lower TEST light OFF.

Repair open in ground circuit wiring, then retest.

Check for MAF Signal Wire Shorts to Chassis Ground, Sensor Power, Remaining Pins

NOTE: Short circuits in the MAF signal wire rarely occur. This test is shown for reference, but it may be skipped (go to step 19) with little chance of missing a potential problem.

12) **Verify Ignition key OFF.**

13) **Disconnect vehicle harness connector from engine computer.**

14) **Verify POWER switch on CONTINUITY / 9V BATT. CHECK.**
- FUNCTION switch in any position.

15) **RED probe to MAF signal pin (harness connector), BLACK clip to good chassis ground.**
- Good circuit (no short): Lower TEST light OFF.
- Bad circuit (shorted): Lower TEST light ON brightly.

16) **RED probe to MAF power pin (harness connector), BLACK clip to MAF signal pin (harness connector).**
- Good circuit (no short): Lower TEST light OFF.
- Bad circuit (shorted): Lower TEST light ON brightly.

17) **RED probe to MAF signal pin (harness connector), BLACK clip to any untested pin (harness connector).**
- Good circuit (no short): Lower TEST light OFF.
- Bad circuit (shorted): Lower TEST light ON brightly.

NOTE: Repeat step 17 for all untested connector pins.

Repair wiring shorts if necessary, then retest. If no trouble found, proceed to next step.

18) **Reconnect Engine Computer.**

19) **Disconnect Sensor Probe and reconnect MAF sensor.**

ACTION TO TAKE

If the preceding Additional Checks are all good (but the MAF sensor test is not O.K.) then the sensor is bad and needs to be replaced.

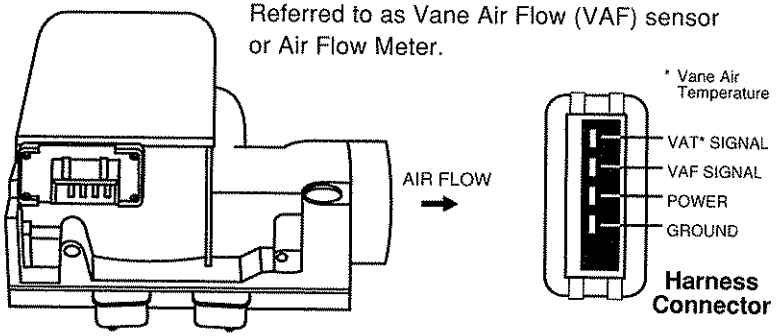
Notes

Notes

Section 4

Testing VAF Sensors

Referred to as Vane Air Flow (VAF) sensor or Air Flow Meter.



TYPICAL VAF SENSOR

What is It?

This sensor sends a dc voltage signal to the computer indicating the amount of air entering the engine. The voltage signal increases as the air flow increases. The sensor assembly has a pivoting door ("vane") which is opened by incoming air. The vane is connected to a potentiometer (a variable resistor – like a dashboard dimmer control) which generates the voltage signal. (Note: Some VAF sensor assemblies also contain an air temperature sensor. Refer to section 6 for temperature sensor test steps.)

How is it Used?

The computer needs to know incoming air flow to properly adjust air/fuel mixture and ignition timing for varying engine load and operating conditions.

Location

The sensor is mounted in the engine incoming air duct – between the air cleaner and the throttle body.

When to Check

Related trouble codes sent by computer. Driveability problems such as hard starting, stalling, rough idle, hesitation, stumble, surging, poor fuel economy, black exhaust smoke, knocking, backfiring, catalytic converter overheating or no torque converter lock-up.

VAF SENSOR TEST PROCEDURE

Important: *Sensor remains mounted on vehicle and connected to wiring harness!*

Warning: *Test involves running engine. Observe all safety precautions (see page iv). Work in well ventilated area.*

1) **Ignition key OFF.**

2) **Check Sensor Probe battery.**
   - Refer to Section 1, page 1-4.

3) **Set switches:**
   - POWER switch OFF.
   - FUNCTION switch on DC VOLTS.

4) **Connect test leads.**
   - BLACK test clip to good vehicle ground. (Negative terminal on vehicle battery is best.)
   - RED test probe: pierce VAF signal wire. (Refer to page 4-5.)
   - Make sure all connections are good!

5) **POWER switch ON.**

6) **Ignition key ON but DO NOT START ENGINE.**
   - Observe TEST lights – compare to TEST RESULTS chart.

7) **Start engine – let idle.**
   - Observe TEST lights - compare to TEST RESULTS chart.

8) **Rev engine momentarily.**
   - Observe TEST lights – compare to TEST RESULTS chart.

9) **Ignition key OFF.** Evaluate test results (see below).
   - POWER switch OFF.
   - Disconnect RED test probe.

TEST RESULTS

☼ = Bright
◍ = Dim
● = Off

Chart below shows typical results. Actual performance may vary due to test conditions.

	Key ON Engine OFF	Idle	Engine Rev
FORD			

ACTION TO TAKE

TEST lights O.K.

- VAF sensor is functional.
- Testing is complete. Disconnect Sensor Probe.

NOTE: If TEST lights are O.K. but a computer trouble code indicates a bad sensor signal, the wire between the VAF sensor signal pin and the computer may be open.

TEST lights NOT O.K.

- Additional checks necessary to pinpoint problem.

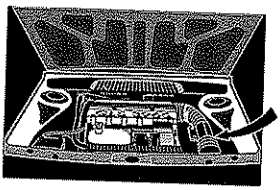
1) **Check intake air path (page 4-4).**
   If O.K. then...
2) **Check sensor connectors (page 4-4).**
   If O.K. then...
3) **Check sensor power, ground and signal circuits (starts on page 4-4).**
   If O.K. then...
4) **Replace bad VAF sensor.**

ADDITIONAL CHECKS TO MAKE IF TEST RESULTS ARE NOT O.K.

Make these checks to avoid replacing a good sensor!

IMPORTANT: *Observe all safety precautions (see page iv).*

Check for Air Intake Problems



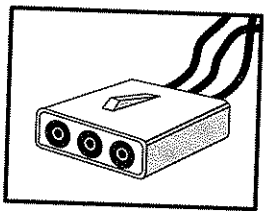
1) **Ignition key OFF.**

2) **Check for:**

- Air leaks - around VAF sensor, ductwork or throttle body.
- Obstructions in air duct.
- Clogged air filter.

Repair as necessary, then retest. If no trouble found, proceed to next step.

Check for Connector Problems



3) **Disconnect VAF harness connector.**

- Check connector for:

– Corrosion on pins.

– Bent or damaged pins.

– Contacts not properly seated in housing.

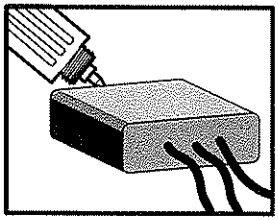
– Bad wire crimps to terminals.

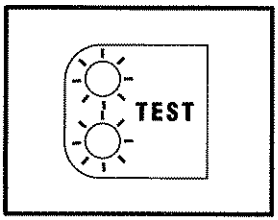
Repair as necessary, then retest. If no trouble found, proceed to next step.

Check for Power Going to Sensor

4) **Verify BLACK test clip connected to good vehicle ground.**

5) **Ignition key ON - but DO NOT START ENGINE.**





6) **POWER switch ON**

FUNCTION switch on DC VOLTS.

7) **Touch RED probe to power pin in VAF harness connector.**

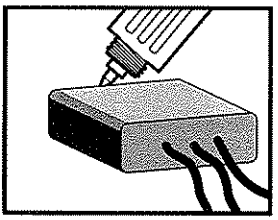
- **Good Power Circuit:** Both TEST lights ON brightly.

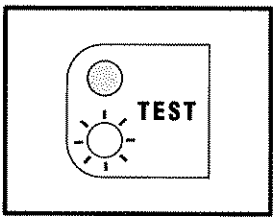
Proceed to next step.

- **Bad Power Circuit:** One or both TEST lights OFF or dim.

Repair open or short in power circuit wiring, then retest.

Check For Good Sensor Ground





8) **Ignition key OFF.**

9) **Verify BLACK test clip connected to good vehicle ground.**

10) **POWER switch on CONTINUITY / 9V BATT. CHECK.**

- FUNCTION switch in any position.

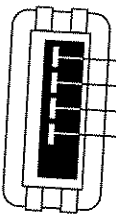
11) **Touch RED probe to ground pin in VAF harness connector.**

- **Good Ground Circuit:** Lower TEST light ON brightly.

Proceed to next step.

- **Bad Ground Circuit:** Lower TEST light OFF.

Repair open in ground circuit wiring, then retest.



Harness Connector

Check for VAF Signal Wire Shorts to Chassis Ground, Sensor Power, Remaining Pins

NOTE: Short circuits in the VAF signal wire rarely occur. This test is shown for reference, but it may be skipped (go to step 19) with little chance of missing a potential problem.

12) Verify Ignition key OFF.

13) Disconnect vehicle harness connector from engine computer.

14) Verify POWER switch on CONTINUITY / 9V BATT. CHECK.

- FUNCTION switch in any position.

15) RED probe to VAF signal pin (harness connector), BLACK clip to good chassis ground.

- **Good circuit** (no short): Lower TEST light OFF.
- **Bad circuit** (shorted): Lower TEST light ON brightly.

16) RED probe to VAF power pin (harness connector), BLACK clip to VAF signal pin (harness connector).

- **Good circuit** (no short): Lower TEST light OFF.
- **Bad circuit** (shorted): Lower TEST light ON brightly.

17) RED probe to VAF signal pin (harness connector), BLACK clip to any untested pin (harness connector).

- **Good circuit** (no short): Lower TEST light OFF.
- **Bad circuit** (shorted): Lower TEST light ON brightly.

NOTE: Repeat step 17 for all untested connector pins.

Repair wiring shorts if necessary, then retest. If no trouble found, proceed to next step.

18) Reconnect Engine Computer.

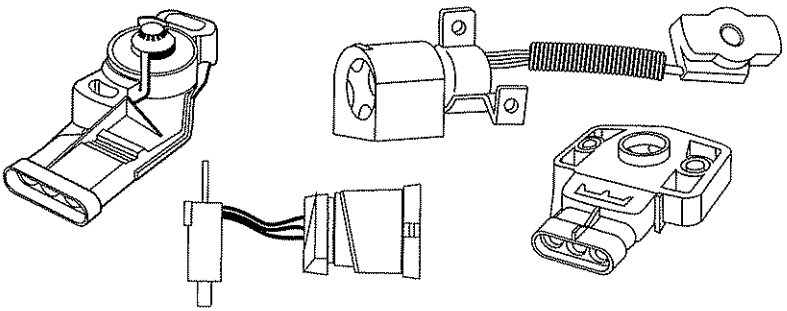
19) Disconnect Sensor Probe and reconnect VAF sensor.

ACTION TO TAKE

If the preceding Additional Checks are all good (but the VAF sensor test is not O.K.) then the sensor is bad and needs to be replaced.

Section 5 Testing Position Sensors

THROTTLE POSITION



TYPICAL THROTTLE POSITION SENSORS

What is It?

The throttle position (TP) sensor is a potentiometer – a type of variable resistor (similar to a dashboard light dimmer control). These sensors come in a wide variety of styles – some with connectors at the end of a short wire "pigtail." The computer supplies power and ground to the sensor. The sensor has an element which is turned (rotary type) or pushed (linear type). When the sensor is mounted on the engine, the element is linked to the throttle so they move together. The sensor sends out a voltage signal indicating element (and thus throttle) position. The voltage signal gets larger the more the element is moved.

How is it Used?

The computer uses throttle position to determine the engine operating condition: idle (closed throttle), cruise (part throttle) or hard acceleration (wide open throttle). Then, the computer can properly control air/fuel mixture, spark advance, idle speed and lock-up torque converter.

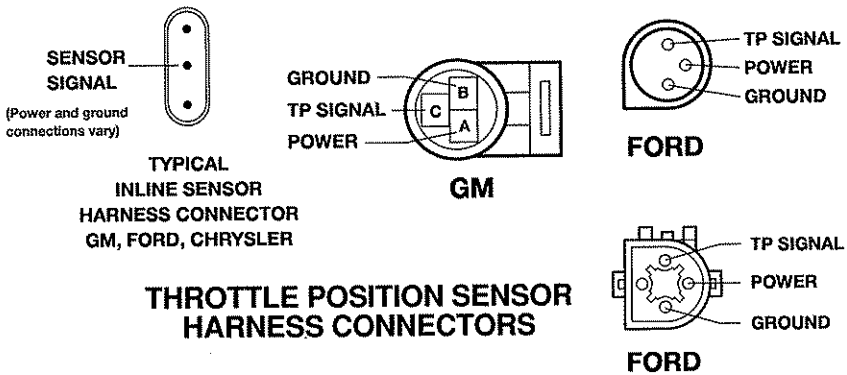
Location

Rotary type: Mostly used on fuel injected engines. Mounted to outside of throttle body – linked to throttle shaft.

Linear (sliding) type: Mostly used on carburetored engines. Mounted inside the carburetor (typical GM) or outside the carburetor (some Ford).

When to Check

Related trouble codes sent by computer. Driveability problems such as hard starting, stalling, rough idle, erratic idle, hesitation, stumble, surging, poor fuel economy, knocking (pinging), backfiring, no torque converter "lock-up."



THROTTLE POSITION SENSOR HARNESS CONNECTORS

THROTTLE POSITION (TP) SENSOR TEST PROCEDURE

Important: *Sensor remains mounted on vehicle and connected to wiring harness!*

Warning: *Observe all safety precautions (see page iv) when working on vehicle.*

1) **Ignition key OFF.**

2) **Check Sensor Probe battery.**
   - Refer to Section 1, page 1-4.

3) **Set switches:**
   - POWER switch OFF.
   - FUNCTION switch on DC VOLTS.

4) **Connect test leads.**
   - BLACK test clip to good vehicle ground. (Negative terminal on vehicle battery is best.)
   - RED test probe: pierce TP signal wire (center wire in TP harness connector).
   - Make sure all connections are good!

5) **POWER switch ON.**

6) **Ignition key ON but DO NOT START ENGINE.**

7) **Slowly open and close throttle.**
   - Observe TEST lights – compare to TEST RESULTS chart.

8) **Ignition key OFF – Evaluate test results.**
   - POWER switch OFF.
   - Disconnect RED test probe.

TEST RESULTS

☼ = Bright
◌ = Dim
● = Off

Chart below shows typical results. Actual performance may differ due to variations in test conditions and sensor mounting.

TEST LIGHTS						THROTTLE POSITION
	●	●	●	◌	☼	
	●	◌	☼	☼	☼	

← Closed – Open →

See next page for ACTION TO TAKE.

THROTTLE POSITION

ACTION TO TAKE

TEST lights O.K.

- Throttle position sensor is functional.
- Testing is complete. Disconnect Sensor Probe.

NOTE: If TEST lights are O.K. but a computer trouble code indicates a bad sensor signal, the wire between the sensor signal pin and the computer may be open.

TEST lights NOT O.K.

(Blinks, flickers or no change in brightness during sensor operation.)

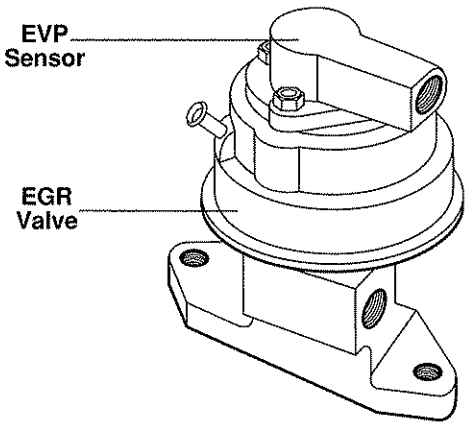
- Additional checks necessary to pinpoint problem.

1) **Check for mechanical problems (see page 5-8).**
   (These can generate engine computer trouble codes.)
   If O.K. then...

2) **Check sensor connectors (see page 5-8).**
   If O.K. then...

3) **Check sensor power, ground and signal circuits (see page 5-8).**
   If O.K. then...

4) **Replace bad throttle position sensor.**



What is It?

The EGR Valve Position (EVP) sensor is a potentiometer - a type of variable resistor (similar to a dashboard light dimmer control). The computer supplies power and ground to the sensor. The sensor has a shaft which is pushed. When the sensor is mounted on the EGR valve, the shaft gets pushed as the valve opens. The sensor sends out a voltage signal indicating the amount of valve opening. The voltage signal gets larger the more the EGR valve is opened.

How is it Used?

The computer is programmed to provide an optimum amount of EGR flow during idle, cruise and hard acceleration operating conditions. The computer uses the sensor signal to calculate actual EGR flow. Then the computer can modify the EGR valve opening as required.

Location

The sensor is bolted to the top of the EGR valve.

When to Check

Related trouble codes sent by computer. Driveability problems such as hesitation, stumble, surging, poor fuel economy, erratic acceleration, knocking (pinging), no torque converter "lock-up."

EGR VALVE POSITION (EVP) SENSOR TEST PROCEDURE

Important: *Sensor remains mounted on vehicle and connected to wiring harness!*

Warning: *Observe all safety precautions (see page iv) when working on vehicle.*

1) **Ignition key OFF.**

2) **Check Sensor Probe battery.**
   - Refer to Section 1, page 1-4.

3) **Set switches:**
   - POWER switch OFF.
   - FUNCTION switch on DC VOLTS.

4) **Connect test leads.**
   - BLACK test clip to good vehicle ground. (Negative terminal on vehicle battery is best.)
   - RED test probe: pierce EVP signal wire.
   - Make sure all connections are good!

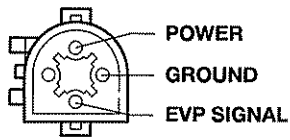
5) **POWER switch ON.**

6) **Ignition key ON but DO NOT START ENGINE.**

7) **Operate EGR Valve Position sensor.**
   - Remove vacuum hose from EGR valve.
   - Connect hand vacuum pump.
   - Gradually apply vacuum to slowly open valve.
   - Observe TEST lights – refer to TEST RESULTS chart.

   OR:
   - Remove sensor from EGR valve.
   - Slowly push sensor element inwards (same as opening EGR valve).
   - Observe TEST lights – refer to TEST RESULTS chart.

EGR Valve Position Sensor Harness Connector (FORD)



8) **Ignition key OFF – Evaluate test results.**
   - POWER switch OFF.
   - Disconnect RED test probe.
   - Reconnect sensor and vacuum hose to EGR valve if necessary.

☼ = Bright
◍ = Dim
● = Off

TEST RESULTS

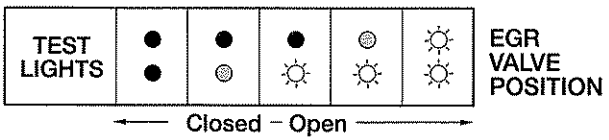


Chart shows typical results. Actual performance may differ due to variations in test conditions and sensor mounting.

ACTION TO TAKE

TEST lights O.K.
- EGR valve position sensor is functional.
- Testing is complete. Disconnect Sensor Probe.

NOTE: If TEST lights are O.K. but a computer trouble code indicates a bad sensor signal, the wire between the sensor signal pin and the computer may be open.

TEST lights NOT O.K. (Blinks, flickers or no change in brightness during sensor operation.)
- Additional checks necessary to pinpoint problem.

1) **Check for mechanical problems (see page 5-8).** (These can generate engine computer trouble codes.)
   If O.K. then...
2) **Check sensor connectors (see page 5-8).**
   If O.K. then...
3) **Check sensor power, ground and signal circuits (see page 5-8).**
   If O.K. then...
4) **Replace bad EGR valve position sensor.**

ADDITIONAL CHECKS TO MAKE IF TEST RESULTS ARE NOT O.K.

(Throttle Position sensor or EGR Valve Position sensor)

Make these checks to avoid replacing a good sensor!

IMPORTANT: *Observe all safety precautions (see page iv).*

Check for Mechanical Problems

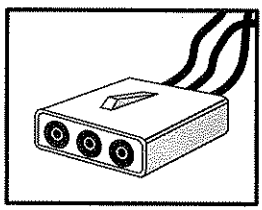
(These can generate engine computer trouble codes.)

1) **Ignition key OFF.**
2) **When testing Throttle Position sensor - check for:**
   - Binding throttle shaft or linkage.
   - If used: "Cruise Control" linkage problems.
   - Idle speed control, choke, or cam systems affecting throttle position.

   When testing EGR Valve Position sensor - check for:
   - Damaged or sticking EGR valve.
   - Worn or broken vacuum lines, vacuum connectors.
   - Damaged vacuum reservoir, cannister.
   - Problems with control solenoids supplying operating vacuum to open EGR valve.

   Repair as necessary, then retest. If no trouble found, proceed to next step.

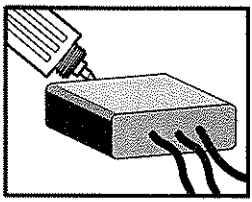
Check for Connector Problems

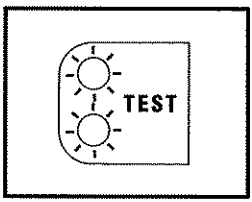


3) **Disconnect sensor harness connector.**
   - Check connector for:
   - – Corrosion on pins.
   - – Bent or damaged pins.
   - – Contacts not properly seated in housing.
   - – Bad wire crimps to terminals.

   Repair as necessary, then retest. If no trouble found, proceed to next step.

Check for Power Going to Sensor





4) **Verify BLACK test clip connected to good vehicle ground.**
5) **Ignition key ON – but DO NOT START ENGINE.**
6) **POWER switch ON**
   FUNCTION switch on DC VOLTS.
7) **Touch RED probe to power pin in sensor harness connector.**

   Power pin location unknown? Try each pin except signal. A "good" indication (both TEST lights ON brightly) identifies the power pin. The remaining pin is the ground pin tested next (step 8 to step 11). If neither pin gives a "good" indication, there is a problem in the sensor power circuit which needs repair before continuing. (Refer to vehicle service manual.)

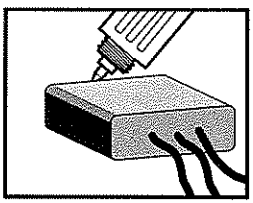
   • **Good Power Circuit:** Both TEST lights ON brightly.

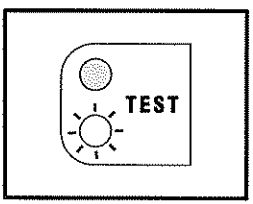
   Proceed to next step.

   • **Bad Power Circuit:** One or both TEST lights OFF or dim.

   Repair open or short in power circuit wiring, then retest.

Check For Good Sensor Ground





8) **Ignition key OFF.**
9) **Verify BLACK test clip connected to good vehicle ground.**
10) **POWER switch on CONTINUITY / 9V BATT. CHECK.**
    • **FUNCTION switch in any position.**
11) **Touch RED probe to ground pin in sensor harness connector.**

    • **Good Ground Circuit:** Lower TEST light ON brightly.

    Proceed to next step.

    • **Bad Ground Circuit:** Lower TEST light OFF.

    Repair open in ground circuit wiring, then retest.

Check for Sensor Signal Wire Shorts to Chassis Ground, Sensor Ground or Sensor Power

NOTE: Short circuits in the sensor signal wire rarely occur. This test is shown for reference, but it may be skipped (go to step 19) with little chance of missing a potential problem.

12) Verify Ignition key OFF.

13) Disconnect vehicle harness connector from engine computer.

14) Verify POWER switch on CONTINUITY / 9V BATT. CHECK.

- FUNCTION switch in any position.

15) RED probe to sensor signal pin (harness connector), BLACK clip to good chassis ground.

- **Good circuit** (no short): Lower TEST light OFF.
- **Bad circuit** (shorted): Lower TEST light ON brightly.

16) RED probe to sensor signal pin (harness connector), BLACK clip to sensor ground pin (harness connector).

- **Good circuit** (no short): Lower TEST light OFF.
- **Bad circuit** (shorted): Lower TEST light ON brightly.

17) RED probe to sensor power pin (harness connector), BLACK clip to sensor signal pin (harness connector).

- **Good circuit** (no short): Lower TEST light OFF.
- **Bad circuit** (shorted): Lower TEST light ON brightly.

Repair wiring shorts if necessary, then retest. If no trouble found, proceed to next step.

18) Reconnect engine computer.

19) Disconnect Sensor Probe and reconnect sensor connector.

ACTION TO TAKE

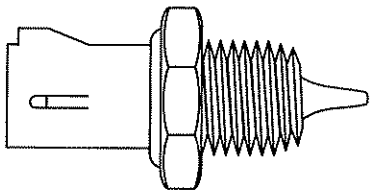
If the preceding Additional Checks are all good (but the sensor test is not O.K.) then the sensor is bad and needs to be replaced.

Section 6

Testing Temperature Sensors

Engine TEMPERATURE

Referred to as Coolant Temperature sensor, Engine Coolant Temperature sensor or similar names



TYPICAL ENGINE COOLANT TEMPERATURE SENSOR

What is It?

The engine temperature sensor is a thermistor - a resistor whose resistance changes with temperature. The hotter the sensor gets, the lower the resistance becomes. The thermistor is mounted inside the tip of a threaded metal housing. This is a 2-wire sensor. (Exception: some Chrysler engines have a dual sensor with 3 wires.)

How is it Used?

The computer needs to know engine temperature so it can modify air/fuel ratio, spark advance, idle speed and emission device operation (such as EGR valve).

Location

The sensor is threaded into the engine block to give it direct contact with the engine coolant.

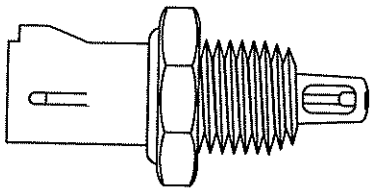
When to Check

Related trouble codes sent by computer. Driveability problems such as hard starting, stalling, rough idle, hesitation, stumble, surging, knocking (pinging), poor fuel economy or black exhaust smoke.

Test procedure begins on page 6-3.

Inlet Air TEMPERATURE

Referred to as Manifold Air Temperature sensor, Air Charge Temperature sensor, Throttle Body Temperature sensor, Vane Air Temperature sensor or similar names



TYPICAL AIR TEMPERATURE SENSOR

What is It?

The inlet air temperature sensor is a thermistor – a resistor whose resistance changes with temperature. The hotter the sensor gets, the lower the resistance becomes. The thermistor is mounted in the tip of a threaded metal housing. This is a 2-wire sensor.

How is it Used?

The computer needs to know air temperature to calculate the amount of air entering the engine. Then, the computer can provide the proper air/fuel mixture for the desired operating condition.

Location

The sensor is threaded into the intake manifold, throttle body or elsewhere along the path of air entering the engine. Sometimes this sensor is built into a Mass Air Flow (MAF) or Vane Air Flow (VAF) sensor assembly. One connector handles both the air flow and temperature sensor circuits. Refer to section 3 (MAF) or section 4 (VAF).

When to Check

Related trouble codes sent by computer. Driveability problems such as hard starting, stalling, rough idle, hesitation, stumble, surging, poor fuel economy or black exhaust smoke.

TEMPERATURE SENSOR TEST PROCEDURE

Use this procedure for all engine temperature or inlet air temperature sensors.

Important: *Sensor remains mounted on vehicle and connected to wiring harness!*

Warning: *Test involves running engine. Observe all safety precautions (see page iv). Work in well ventilated area.*

1) **Engine cold – ignition key OFF.**

2) **Check Sensor Probe battery.**
   - Refer to Section 1, page 1-4.

3) **Set switches:**
   - POWER switch OFF.
   - FUNCTION switch on DC VOLTS.

4) **Connect test leads.**
   - BLACK test clip to good vehicle ground. (Negative terminal on vehicle battery is best.)
   - RED test probe: pierce sensor signal wire.
   - Make sure all connections are good!

5) **POWER switch ON.**

6) **Ignition key ON but DO NOT START ENGINE.**
   - Observe TEST lights – compare to TEST RESULTS chart.

7) **Start engine – let idle/warm-up.**
   - Observe TEST lights – compare to TEST RESULTS chart.

8) **Ignition key OFF – Evaluate test results.**
   - POWER switch OFF.
   - Disconnect RED test probe.

Where's the Signal Wire?

Wire colors vary considerably. The Ground wire is usually black, black with a color stripe or purple. The Signal wire is usually a non-black color (except black with a red stripe on some Chrysler). To be certain, refer to Vehicle Service Manual or do the following:

- Disconnect sensor connector.
- POWER switch ON, FUNCTION switch DC VOLTS, BLACK test clip on vehicle ground.
- Ignition key ON but don't start engine.
- Touch RED probe to each pin.

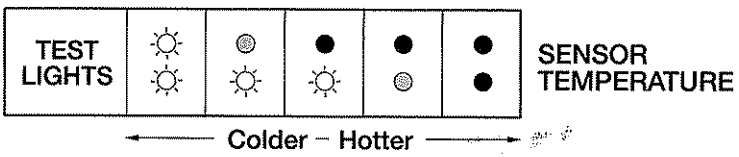
A voltage indication (both TEST lights ON brightly) identifies the signal pin. The remaining pin is the ground pin. If neither pin gives a voltage indication, there is a problem in the sensor signal circuit which needs repair before continuing. (Refer to vehicle service manual.)

- Ignition key OFF.
- Reconnect sensor connector.

☼ = Bright
◍ = Dim
● = Off

TEST RESULTS

Chart below shows typical results. Actual performance may vary due to test conditions.



NOTE: Some Chrysler systems have a two stage signal action. As the engine warms up, the TEST lights will gradually dim down, then suddenly get bright, then dim down once again. This is normal.

ACTION TO TAKE

TEST lights O.K.

- Temperature sensor is functional.
- Testing is complete. Disconnect Sensor Probe.

TEST lights NOT O.K.

- Additional checks necessary to pinpoint problem.

1) **Check for mechanical problems (see next page).**

   If O.K. then...

2) **Check sensor connectors (see next page).**

   If O.K. then...

3) **Check sensor signal and ground circuits (see next page).**

   If O.K. then...

4) **Replace bad temperature sensor.**

ADDITIONAL CHECKS TO MAKE IF TEST RESULTS ARE NOT O.K.

(Engine Coolant Temperature sensor or Inlet Air Temperature sensor)

Make these checks to avoid replacing a good sensor!

IMPORTANT: *Observe all safety precautions (see page iv).*

Check for Mechanical Problems

(These can generate engine computer trouble codes.)

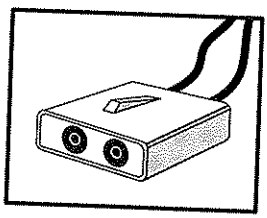
1) **Ignition key OFF.**

2) **Check for:**

- Contamination build-up on sensor causing poor response.
- Engine cooling system problems (antifreeze, thermostat, water pump, fan, belts).
- Low engine oil level.
- Blocked or restricted air passageways.

Repair as necessary, then retest. If no trouble found, proceed to next step.

Check for Connector Problems

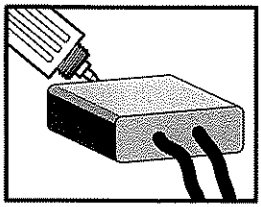


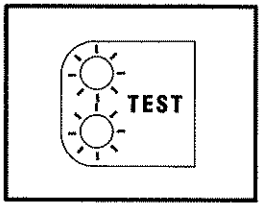
3) **Disconnect sensor harness connector.**

- Check connector for:
  - Corrosion on pins.
  - Bent or damaged pins.
  - Contacts not properly seated in housing.
  - Bad wire crimps to terminals.

Repair as necessary, then retest. If no trouble found, proceed to next step.

Check Signal Circuit Voltage





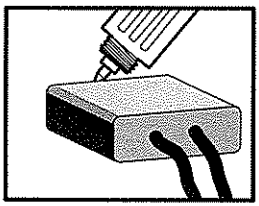
4) **Verify BLACK test clip connected to good vehicle ground.**
5) **Ignition key ON – but DO NOT START ENGINE.**
6) **POWER switch ON.**
   FUNCTION switch on DC VOLTS.
7) **Touch RED probe to signal pin in sensor harness connector.**
   - **Good Signal Circuit:** Both TEST lights ON brightly.

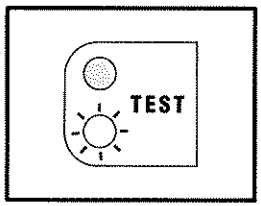
   Proceed to next step.

   - **Bad Signal Circuit:** One or both TEST lights OFF or dim.

Repair open or short in power circuit wiring, then retest.

Check For Good Sensor Ground





8) **Ignition key OFF.**
9) **Verify BLACK test clip connected to good vehicle ground.**
10) **POWER switch on CONTINUITY / 9V BATT. CHECK.**
    FUNCTION switch in any position.
11) **Touch RED probe to ground pin in sensor harness connector.**
    - **Good Ground Circuit:** Lower TEST light ON brightly.

    Proceed to next step.

    - **Bad Ground Circuit:** Lower TEST light OFF.

Repair open in ground circuit wiring, then retest.

Check for Sensor Signal Wire Shorts to Chassis Ground or Sensor Ground

NOTE: Short circuits in the sensor signal wire rarely occur. This test is shown for reference, but it may be skipped (go to step 18) with little chance of missing a potential problem.

12) **Verify Ignition key OFF.**

13) **Disconnect vehicle harness connector from engine computer.**

14) **Verify POWER switch on CONTINUITY / 9V BATT. CHECK.**

- **FUNCTION switch in any position.**

15) **RED probe to sensor signal pin (harness connector), BLACK clip to good chassis ground.**

- **Good circuit (no short):** Lower TEST light OFF.
- **Bad circuit (shorted):** Lower TEST light ON brightly.

16) **RED probe to sensor signal pin (harness connector), BLACK clip to sensor ground pin (harness connector).**

- **Good circuit (no short):** Lower TEST light OFF.
- **Bad circuit (shorted):** Lower TEST light ON brightly.

17) **Reconnect engine computer.**

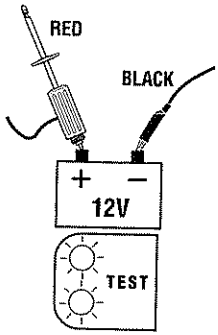
18) **Disconnect Sensor Probe and reconnect sensor connector.**

ACTION TO TAKE

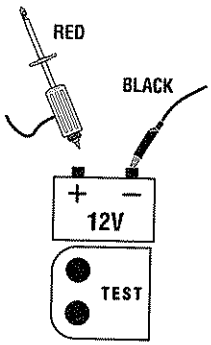
If the preceding Additional Checks are all good (but the sensor test is not O.K.) then the sensor is bad and needs to be replaced.

Section 7

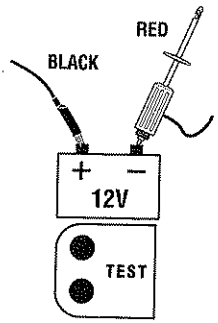
More Uses for the Sensor Probe



POSITIVE VOLTS



NO VOLTS



NEGATIVE VOLTS

"CIRCUIT TESTER" VOLTAGE CHECKS

This function is useful for checking voltages throughout the vehicle electrical system. Many vehicle service manuals use a "circuit tester" in their test procedures. The Sensor Probe may be substituted in most cases.

Warning: *Observe all safety precautions when working on-car (see page iv.)*

1) **Set POWER switch to ON position.**
   Set FUNCTION switch to DC VOLTS.
2) **Connect BLACK test lead to circuit ground.**
3) **Probe with RED test lead.**

Warning: Do not connect to secondary ignition circuits - dangerous voltages present!

4) **Positive voltages applied to RED test lead will light the TEST lights as shown below.**

TEST LIGHTS	● ●	● ○	● ☼	○ ☼	☼ ☼
VOLTS	0.5 or less	1	2.5	3	5 or more

☼ = Bright
○ = Dim
● = Off

IMPORTANT:

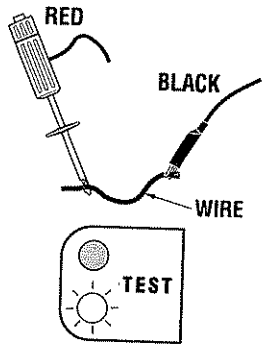
- The TEST lights are low power – safe for computer circuits.
- Negative voltages, no matter how large, will NOT turn on the TEST lights.
- Always make sure all connections are good at the contact points.

Continuity Checks

Test wiring, ground connections, switch operation, relay contacts, or similar.

Test unpowered circuits only.

Warning: *If working on-car, turn ignition key OFF and observe all safety precautions (see page iv.)*



CONTINUITY (good wire)

1) **Set POWER switch to CONTINUITY / 9V BATT. CHECK position.**

   (FUNCTION switch may be on any position.)

2) **Use RED and BLACK test leads:**

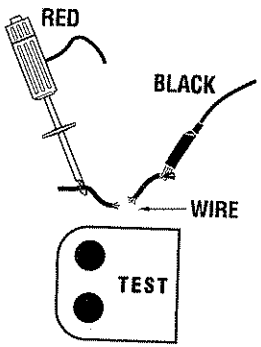
   - Connect RED test lead to one end of circuit (such as wire, switch, relay contact).
   - Connect BLACK test lead to other end of wire, switch, relay.

3) **Observe TEST lights:**

   - Lower TEST light ON means continuity (continuous circuit) exists between Red and Black test leads.
   - Lower TEST light OFF means no continuity (open circuit) exists between Red and Black test leads.

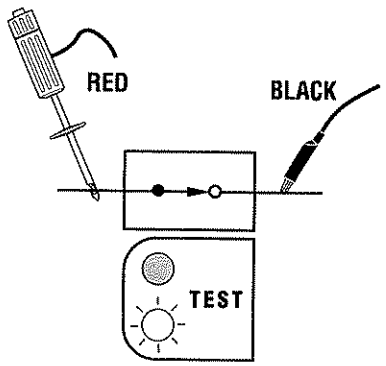
4) **Set POWER switch to OFF when testing is complete.**

   NOTE: Always make sure all connections are good. If necessary, scrape away corrosion, paint, etc. at the contact points.

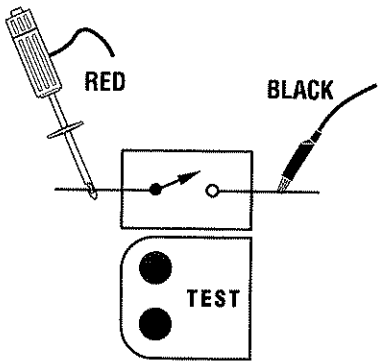


NO CONTINUITY (broken wire)

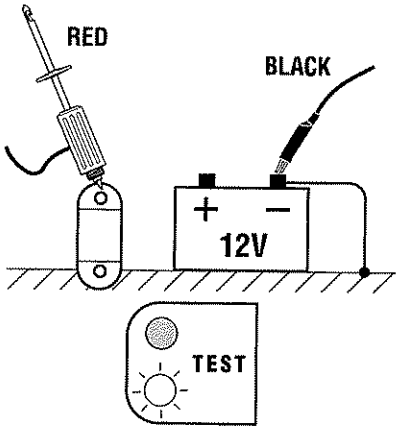
Continuity Checks (con't.)



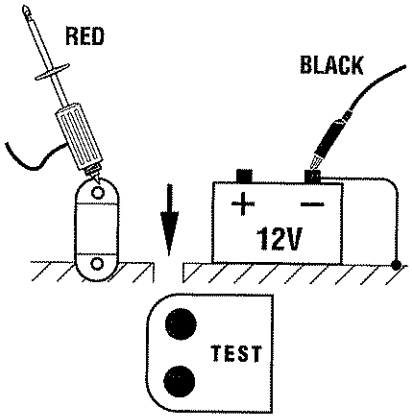
SWITCH CLOSED



SWITCH OPEN



GROUND CONNECTION



NO GROUND CONNECTION

☼ = Bright
◌ = Dim
● = Off

Diode Checks

Tests diodes and rectifiers for proper operation.

1) **Set POWER switch to CONTINUITY / 9V BATT. CHECK position.**

   (FUNCTION switch may be on any position.)

2) **Refer to Figure 1 below:**

   • Connect RED test lead to anode end of diode.

   • Connect BLACK test lead to cathode end of diode.

3) **Lower TEST light should be ON. If the light is off, the diode is defective (open circuit).**

4) **Reverse test lead connections to diode. (Refer to Figure 2 below.)**

   • Connect RED test lead to cathode end of diode.

   • Connect BLACK test lead to anode end of diode.

5) **Lower TEST light should be OFF. If the light is on, the diode is defective (short circuit).**

6) **Set POWER switch to OFF. Testing is complete.**

   NOTE: Always make sure all connections are good. If necessary, scrape away corrosion, paint, etc. at the contact points.

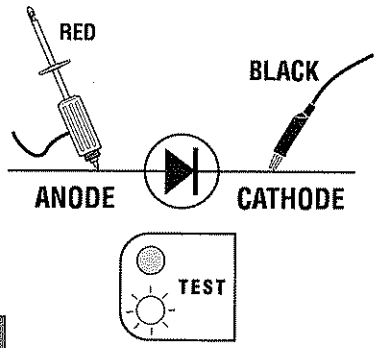


Figure 1

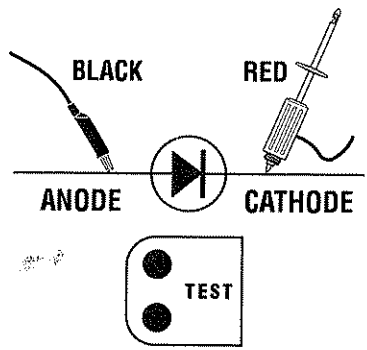


Figure 2